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Applicants:	HALAMODA et al.	Confirmation:	6117
Serial No.:	10/753,874	Group Art Unit:	3724
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For:	DEVICE FOR PUNCHING GREEN SHEETS		

RESPONSE TO NOTICE

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

April 2, 2009

Sir:

In response to the Notification of Non-Compliant Appeal Brief dated December 31, 2008, please substitute the attached Summary of the Claimed Subject Matter for that included in the Brief filed December 1, 2008.

Respectfully submitted,
FITCH, EVEN, TABIN & FLANNERY

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Summary of Claimed Subject Matter

The present invention is directed to a device for punching holes in unfired ceramic substrates, so called green sheets for use particularly for electronic circuit boards. It is well known that circuit boards for electronic circuits are made of ceramic which then are provided with conductors on one or both sides as well as electronic devices. In order to connect conductors on one side of the board to conductors or components on the other side, so called vias are provided. A via is formed by a hole that is metallized during the production process in order to form an electrically conductive path from one side of the ceramic circuit board to the other.

It is nearly impossible to drill these holes into a fired ceramic board as precisely as desired and with high productivity. Therefore, the holes are punched into the ceramic sheet before it is fired. These unfired or "green" sheets, however, have a considerable thickness. While it is desirable for the thickness of the ceramic green sheet to be rather high in order to obtain a high degree of stiffness and rigidity, the diameter of the holes to be punched is becoming smaller and smaller as a result of decreased dimensions for the conductors and components. For example, while the desired diameter of the holes used to be much larger than 0.1 millimeters, the desired diameter of the holes is currently much less. In particular, diameters of 0.06 millimeters and less are to be achieved.

This desired decrease in the diameter of the holes to be produced created a problem in view of the design of the prior art punch. In the punch, the length of the cylindrical punching portion has to be equal to or greater than the thickness of the green sheet. Moreover, if the working part of the punch is used to guide the punch, the length of the working part has to additionally be increased. Examples of standard designs of punches of this type are shown, for example, in U.S. Patent Nos. 4,092,888 and 4,425,829, both of record in the present application. This type punch design works well if the hole to be punched is rather large compared to the thickness of the green sheet, e.g., see FIG. 1 of U.S. Patent No. 4,425,829. However, if the diameter of the hole is very much less than the thickness of the green sheet, then the ratio of the length to the diameter of the punching part will be too large, resulting in the punching part no longer being stable. This instability will cause the punching part of the tool to bend sideward and cause problems if pushed toward the green sheet.

The above described problem, which is generally discussed in paragraphs 002-004 on page 1 of the present application, is solved by the punch according to the present invention, is generally described relative to the problem solution in paragraphs 007-0011 on pages 2 and 3 of the present application. As shown in Fig. 1 and as described in paragraphs 17 –20 of the present application, the punch according to the present invention includes a lower tool 2 and an upper tool 3, with the upper tool 3 being moveable linearly back and forth toward and away from the lower tool 2 on guides 4 and 5. A drive mechanism is connected

to the upper tool 3 to move it linearly by a defined stroke toward and away from the lower tool 2.

The lower tool 2 includes a substantially flat support plate or receiving device 6 provided with a plurality of punched holes 7 at locations at which holes are to be formed in an unfired or green ceramic sheet 32 (see Fig 3) placed on the support plate or receiving device 6. For this purpose, a plurality of dies 8 are disposed on the upper tool 3 in alignment with the holes 7 in the support plate 6. The dies 8 are guided during their travel and a green sheet on the flat support plate 6 is held down by a plate 9, which is omitted in Fig.1 for clarity but is shown in Fig. 2 and partially in Figs. 3 and 4.

The plate 9 is connected to or part of the upper tool 3 and moveable with it. As can be seen in Figs. 2 and 3, the surface of the plate 9 facing the support plate 6 is provided with a stripper bushing 21 containing a stripper opening 24 which is aligned with an opening or punched hole 7 in a punching bushing 22 mounted in the support plate or receiving device 6. The punched hole 7 is a through bore that opens into a slug conduit 28 (See Fig 3) having a greater diameter than the punched hole 7.

As can be seen in Fig 2, and as described in paragraphs 21 and 22, the die has an elongated shaft 15 with a head 14 at one end secured to the upper tool 3. The die 8 is preferably provided with a separate drive mechanism (not shown) for moving it toward and away from the lower tool 2. The shaft 15 extend through a guide device 17 including an elongated bushing 18 mounted in a plate

19 connected to the plate 9 and provided with a central passage whose surface guides the movement of the shaft 15 and thus the die 8. The lower end of the die 8 extends into the stripper opening 24 of the stripper bushing 21.

According to the present invention, instead of the die 8 having two different diameter portions with the lower end or punching portion being smaller than the remainder of the shaft and extending into and being guided by the wall of the stripper opening, the punch or die 8 has three different diameters as can clearly be seen in Figs. 2-4, particularly Figs. 3 and 4. In particular, in addition to the cylindrical shaft 15, the lower operative or working portion of the die 8 is divided into a non laterally supported or unguided cylindrical punching part 26 at the lower end followed by a cylindrical guiding part 25 which is guided by the wall of the stripper opening 24. Consequently, the ratio between the length and the diameter of the punching part 26 is diminished, which results in an increased stiffness thereof. More specifically, in the punching device according to the invention, the die 8 has: 1) a thin short punching portion 26 having a diameter essentially corresponding to the diameter of the desired hole, and thus slightly less than the diameter of the punching hole 7 by a clearance amount; 2), a thicker intermediate guiding portion 25 with a slightly larger diameter corresponding to that of the stripper opening 24; and finally a shaft 15 having a still larger diameter that is a multiple of the diameter of the intermediate guiding portion 25.

As indicated above, the die 8 is mounted above the punching opening 7 in the substantially flat receiving face of the support plate 6 for the green sheet 32' which opening 7 receives the punching portion 26 of the die 8 during a punching operation as described in paragraphs 28 and 29 and as shown in detail in Figs. 3 and 4. The die is mounted so that its shaft portion 15 is guided in the bushing 18 while the cylindrical intermediate portion 25 is guided in the stripper bore or opening 24 of the stripper bushing 21. The length of the stripper opening 24 is greater than that of the cylindrical punching portion 26 of the die 8 so that the punching portion 26 can be withdrawn into the stripper opening 24 while a portion of the intermediate portion 25 is still in the stripper opening 24 and guided thereby. Thus the short punching portion 26, which is not directly guided by the stripper opening 24, is within the stripper when not in use and only exits the stripper opening 24 during a punching action. Moreover, the stroke of the drive mechanism is essentially equal to the length of the punching portion, e.g., see original claim 5, so that only the punching portion 26 at the end of the die 8 performs any punching or other material deformation actions on the green sheet, while the intermediate portion 25 provides only a guiding function for the die 8 near the punching portion 26.

Independent Claim 1 is in many respects the broadest claim and is directed to the above described device for punching unfired, sheet like ceramic substrates, in particular so-called green sheets, with the device initially including, as shown in Figs. 1-4, a receiving device or table 6 having a substantially flat

upper receiving face for a ceramic substrate 32 (see Figs. 3 and 4) and in which a plurality of punched holes 7 are formed as described in paragraphs 0017. A plurality of dies 8 are disposed in the upper tool part 3 above the respective punched holes 7 in the table 6 as likewise shown in the figures and described in paragraph 0017. Each of the dies 8 has a cylindrical shaft 15 and a cylindrical operative portion 23 (see Figs. 2-4 and paragraphs 0021 and 0023-0025) at one end. The operative portion 23 of the die 8 extends through a constant diameter stripper opening 24, which is disposed in a stripper or stripper bush (bushing) 21 above the associated respective punched hole 7 and extends to an outer face of the stripper 21 facing the receiving face as can clearly be seen in Figs 2-4. As discussed in paragraphs 0024 and 0025, the operative portion 23 of the die 8 has a first part 25 with a diameter that is less than the diameter of the shaft 15 by a multiple of the diameter of the first part, and greater than the diameter of the associated punched hole 7, and the first part 25 of the operative portion, at its lower end, has a cylindrical punching portion 26 whose diameter is somewhat less than the diameter of the punched hole 7 and whose length is less than the length of the stripper opening 24. As stated in paragraphs 0020-0023, a drive mechanism is connected in driving fashion to the die 8 in order to move the die linearly by a defined stroke and in the process to move the punching portion 26 into the punched hole 7 and out of it. Moreover, as described in paragraph 0021 and shown in Fig. 2, a die guide device or bushing 17 is provided through which the shaft 15 extends and which guides the die 8 at its shaft 15. Thus the die 8 is

guided in its travel both at its shaft 15 in the bushing 17 and at its cylindrical operative portion 25 in the stripper opening 24. The actual operation of the punch is described in paragraph 0028.

Independent Claims 9 and 18 generally contain all of the features of independent claim 9 but more specifically define additional features of the actual structure of the punching device according to the invention. Claim 9 thus defines a device for punching sheet-like substrates that comprises a receiving device or table 6 having a substantially flat receiving face for a ceramic substrate 32, and having a punched hole 7 formed in the flat surface as can be seen in Fig. 1-4 and described in paragraph 0017. A die 8 is disposed above the punched hole 7, with the die 8 having a shaft portion 15 and an operative portion 23 that extends through and is guided in a constant diameter stripper opening 24 disposed in a stripper or bushing 21 above the punched hole and extending to an outer surface of the stripper 21 facing the upper receiving face of the table 6 (see paragraphs 0021-0025). As clearly seen in Figs. 2-4 and described in paragraphs 0024 and 0025, the operative portion 23 of the die 8 includes a first part 25 that is guided by a surface defining the stripper opening 24 and has a diameter that is less than the diameter of the shaft 15 and greater than the diameter of the punched hole 7, and a second cylindrical punching part 26 that is disposed at a lower end of the first part 25 and has a diameter that is less than the diameter of the first part and slightly less than the diameter of the punched hole 7 and a length that is less than the length of the stripper opening 24 so that a portion of the first part is always guided within the stripper opening, and with the diameter of the shaft being a multiple of the diameter of the first part of the operative portion (see paragraphs 0024-0025). As described in paragraphs 0020-0023, a drive mechanism is connected in driving fashion to the die 8 to move the die linearly by a defined stroke and in the process move the punching part 26 into and out of the

punched hole, and, a die guide or bushing 17 through which the shaft 15 extends and which guides the die shaft 15 is provided (see paragraph 0021)..

Independent claim 18 is more detailed than claim 9 and defines a tool for punching sheet-like substrates that comprises a lower tool part 2 having a substantially flat receiving face 6 for a substrate 32, and having a punched hole 7 formed in the flat face of the lower tool part, and an upper tool part 3 on which a die 8 is mounted as shown in Fig. 1 and described in paragraph 0017. The die 8 has a shaft 15 and a graduated operative portion 23. As described in paragraphs 0021-0025 and shown in Figs 2-4, the die 8 includes a first part 25 with a diameter that is less than the diameter of the shaft 15 and greater than the diameter of the punched hole 7, and a second cylindrical punching part 26 that is disposed at a lower end of the first part 25 and has a diameter that is less than the diameter of the first part 25 and slightly less than the diameter of the punched hole 7. Moreover, as can be seen and as described, the diameter of the shaft 15 is a multiple of the diameter of the first part 25 of the operative portion 23 of the die 8. A linear die guide 17 with a bushing 18 is disposed in the upper tool part 3 above the punched hole 7 as described in paragraph 0021 and shown in Fig. 2. As can be seen in Figs. 2-4 and described in paragraphs 0023-0025, a stripper bush 21 is mounted on a surface of the upper tool part 3 facing the lower tool part 2 and having a constant diameter stripper opening 24 disposed above the punched hole 7 and extending to an outer surface of the stripper bush facing the receiving surface. The die 8 is disposed above the punched hole 7 and mounted in the upper tool part 3 for linear movement toward and away from the lower tool part 2, with the shaft 15 of the die 8 being disposed in and guided by the linear die guide 17. The second punching part 26 of the operative portion 23 of the die 8 has a length that is less than the length of the stripper bush opening , and the first part 25 of the operative portion 23 of the die 8 always extends into the stripper opening 24 and is guided by a wall of the stripper bush 21 defining the stripper opening 24 (see paragraph 0024-0025. A drive mechanism is

connected in driving fashion to the die 8 to move the die linearly by a defined stroke and in the process move the punching part into and out of the punched hole as described in paragraphs 0020-0023 and paragraph 0028.